

Explore the Virtual Side of Earth Science

Three-Dimensional Earth Science Models

Scientists have always struggled to find an appropriate technology that could represent three-dimensional (3-D) data, facilitate dynamic analysis, and encourage on-the-fly interactivity. In the recent past, scientific visualization has increased the scientist's ability to visualize information, but it has not provided the interactive environment necessary for rapidly changing the model or for viewing the model in ways not predetermined by the visualization specialist.

Virtual Reality Modeling Language (VRML 2.0) is a new environment for visualizing 3-D information spaces and is accessible through the Internet with current browser technologies. Researchers from the U.S. Geological Survey (USGS) are using VRML as a scientific visualization tool to help convey complex scientific concepts to various audiences. Kevin W. Laurent, computer scientist, and Maura J. Hogan, technical information specialist, have created a collection of VRML models available through the Internet at Virtual Earth Science (virtual.er.usgs.gov).

Recent Earthquakes

One of the first VRML applications implemented through the USGS Web is a model called Recent Earthquakes (<http://virtual.er.usgs.gov/recent.html>), which is created in real time and is based on the most recent significant earthquakes from around the world as reported by the USGS's National Earthquake Information Center (<http://neic.usgs.gov>). Although this application uses a small subset of earthquakes, the resulting model still conveys the concept that earthquakes tend to occur along plate boundaries. This visualization effectively illustrates the dynamics of plate tectonics.

When demonstrated for school tours and public exhibits, this model was especially well received. Students, parents, and teachers commented on the model's use of real-time data, its accessibility through the

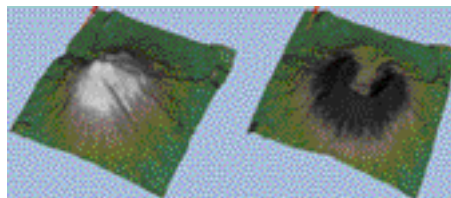
Internet, and its capability of being examined from any perspective. "The students I've worked with are really drawn to the VRML models," said Maura Hogan. "The combination of the computer, the Internet, and highly illustrative graphics captures their imagination and their interest."

Mount St. Helens

Another application, Mount St. Helens: Before and After (<http://virtual.er.usgs.gov/mshCompare.html>), uses USGS digital elevation models (DEM) to create virtual terrains of the volcano before and after its 1980 eruption. The result is a model that helps convey the immense volume of the mountain that was ejected in the eruption.

Earthquakes Inside Volcanoes

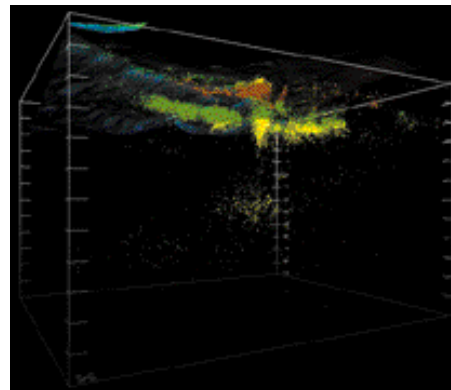
Working with Michael P. Ryan, a USGS volcanologist, Kevin Laurent and Maura Hogan developed several models that use 3-D earthquake locations to hint at a volcano's internal "plumbing system." This plumbing system shows the move-



A model of Mount St. Helens, a volcano in Washington State, before and after its May 18, 1980, eruption.

ment of magma inside a volcano. One of the most recent models is of the island of Hawaii (<http://virtual.er.usgs.gov/Hawaii.html>) and focuses on the area containing Mauna Loa, Kilauea, and Loihi. This model represents the location of more than 27,000 earthquake events recorded over a period of almost 30 years (1969-1997) and allows the user to animate the series of events to show the passage of time.

"Using VRML allows us to render complex data sets in an environment where the scientist can examine the data in



The island of Hawaii hosts both active and dormant volcanoes, including Mauna Loa, Kilauea, and Loihi. This model represents the location of over 27,000 earthquake events recorded over a period of almost 30 years.

ways previously impossible," explains Kevin Laurent. "The scientist's ability to move from visualization to theory formulation is compelling."

VRML is a valuable technology that can enhance the communication of complex scientific concepts. Because it is a Web-enabled technology, anyone can access these information products from any Internet connection and interact with the data as a 3-D information space.

Information

For additional information, contact:

Kevin W. Laurent
12201 Sunrise Valley Drive, MS807
Reston, VA, 20192
klaurent@usgs.gov
<http://virtual.er.usgs.gov>

For information on other USGS products and services, call 1-800-USA-MAPS, use the EARTHFAX fax-on-demand system, which is available 24 hours a day at 703-648-4888, or visit the general interest publications Web site at <http://mapping.usgs.gov/www/products/mappubs.html>.

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